MASTER

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Preliminary results from an investigation into the microclimates of a sheltered area at Rosewarne E.H.S.

W. H. Hogg

Since December 1960 a series of meteorological observations has been made at Rosewarne Experimental Horticulture Station, Camborne, Cornwall. These have been made in O.S.753, Section 2A, with the object of defining some of the microclimatic differences which can arise within a field sheltered by hedges. Section 2A is about 360 ft. long and 70 ft. broad; it runs approximately N-S, with a southerly aspect. On the north side it is bounded by pine trees some 9 ft. high, flanked on the outside by a Cornish hedge topped by gorse also about 9 ft. high. On other sides there are dense hedges of escallonia; that on the west is some 6 ft. 6 in. high, on the east 5 ft. and on the south 6 ft. The field is put down to a ley.

The following meteorological observations are being made daily:-

Air temperature. Maximum and minimum, in screen, 2 ft. above ground.

Bare soil minimum temperature.

Evaporation, measured with a Piche evaporimeter in screen.

Wind, daily run-of-wind from a cup counter anemometer 2 ft. above ground.

Soil temperature. 2" maximum and minimum.

2", 4", 8" soil temperature at 0900 G.M.T.

Observations are being made at 5 sites within the section. At each site, except Site 3, the screen is 2h from the nearest hedge (where h is the height of that hedge) and the anemometer is 3h. The bare plot (2' x 2') containing the soil thermometers and bare soil minimum thermometer is close to the screen. The sites are designated as follows:

Site 1 (Bottom)	2-3h from central part of hedge on S.
Site 2 (West Central)	2-3h from central part of hedge on W.
Site 3 (Mid-Central)	In centre of section.
Site 4 (East Central)	2-3h from central part of hedge on E.
Site 5 (Top)	2-3h from central part of hedge on N.

Similar observations are also made on the completely open agrometeorological station on the top of the ridge, some 360 feet, to the NE (Site 6).

Observations are now available for 13 months (9 months for evaporation), and the notes below indicate the order of differences which are being observed at the various sites. It must be emphasized that these remarks are provisional and are based only on monthly mean values for the various elements; there is no doubt a great deal more interesting information awaiting analysis in the daily values.

Site 1 (Bottom). This is the most sheltered of all the sites and in most months the relative wind (compared with the weather station) is only 40-60%. Evaporation is also low, but in general it is greater than at the top site. The values relative to the weather station range from 65 to 75%. In the spring and summer months afternoon air temperatures are 1-2°F higher than on the unsheltered weather station; the night minima and bare soil minima are somewhat lower than in the open, but not more than 1°F. In winter, the maximum and minimum 2" soil temperatures may be a little below those on the weather station, but in summer they are considerably higher, the maxima by 6°F and the minima by 3°F in some months. The effect fades with depth, but even at 8" summer values show a warming of 3½°F.

/Site 5

Site (5) (Top). This is the next most sheltered site, with a relative wind of 45-90%. Evaporation is low, probably lower than at any other station, but the relative values are very variable (55-85%). In late-spring and summer, afternoon air temperatures are 3-4°F higher than in the open; air minima and bare soil minima are a little lower (up to 1°F). The maximum soil temperatures (2") in the summer are up to 5°F above the weather station values, and the minima up to 1½-2°F higher. In some months this effect is still evident at 8" depth, where July temperatures are 2°F up.

Site 3 (Mid-Central). This is probably the most exposed site in the Section (relative wind 60-100%), though it is little different from Site 4 (East Central) in this respect. It is, however, the site with greatest evaporation (relative values 75-100%). Although it is usually somewhat warmer than the weather station, differences are slight, with the maximum not more than 1.5°F above the weather station; the screen minimum and bare soil minimum tend to be lower than at the weather station. Maximum 2" soil temperatures are 3-4° higher than in the open in late spring and summer, but minima at the same depth are usually within 1°F of the unsheltered values. At 8" depth, differences are all less than 1°F.

Site 4 (East Central). This also is a relatively exposed site, presumably because the protection is on the east. It is, in fact, difficult to be certain whether there is any real difference between Sites 3 and 4 (relative wind 60-100%), but evaporation here tends to be less than at Site 3 (relative values 65-90%). Temperatures are not very different from those at the weather station; the air temperatures are usually within 1°F and the bare soil minimum within 1.5°F. All air maxima are slightly above those in the open, all minima are slightly below. The 2" soil temperatures are usually greater than in the unsheltered site, the maxima by up to 5°F, the minima by about 1°F at the most. At a depth of 8" the differences have almost disappeared and are usually no more than a few tenths of a degree.

Site 2 (West Central). This is the most sheltered of the Central Sites (50-95%), probably because the shelter is on the west. Evaporation (60-85%) is also less than at the other central sites. Afternoon temperatures are higher than at the other sites and in summer they may be 4°F above those in the open; minimum air temperatures are close to those in the open and bare soil minima are 1-1½° lower in late summer and autumn. Soil temperatures are high in the afternoon, the maximum at 2" is up to 5°F above the weather station values; in winter and early spring this site tends to have the highest afternoon soil temperatures; the minimum 2" soil temperatures are closer to those recorded at the weather station, but are about 1½°F higher in summer. As at Site 1 these differences persist to 8" depth, where they amount to 2-3°F in summer.

Shelter indices

In an attempt to integrate shelter effect, each site has been allotted a score in relation to the effect on various elements measured. The scores are as follows:

	Relative values	Score
WIND AND EVAPORATION	⩾ 90	0
	70-89	1
	50-69	2
	< 50	3
TEMPERATURE. AIR MAXIMUM	0 to +0.9	0
	+1.0 to +2.9	1
	+3.0 to +4.9	2
	+5.0 to +6.9	3

/Cont'd.

	Relative values	Score
TEMPERATURE. AIR MINIMUM	0 to -0.9	0
	-1.0 to -2.9	1
	-3.0 to -4.9	2
	-5.0 to -6.9	3
TEMPERATURE. 2" SOIL MAXIMUM and MINIMUM: 2" 0900 SOIL 4" 0900 SOIL	0 to +0.9	0
	1.0 to +2.9	1
	3.0 to +4.9	2
	5.0 to +6.9	3
TEMPERATURE. 8" 0900 SOIL	0 to +0.9	0
	+1.0 to +1.9	1
	+2.0 to +2.9	2
	+3.0 to 3.9	3

Monthly values for each site were allotted and totals for each site regarded as the monthly shelter index. In order to avoid overweighting with respect to soil temperature the scores for 0900 soil temperature at 2" and 4" were excluded from the monthly index figures. The values for 1961 are given below (but note that evaporation was not recorded until March). Tentatively it is suggested that the annual totals may be regarded as the shelter indices for the various sites.

Table I

Monthly and annual shelter indices at Rosewarne, 1961

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1	2	2	5	8	10	13	12	11	10	5	4	5	87
2	1	2	4	3	6	9	13	12	5	5	5	3	68
3	1	0	2	1	4	3	7	6	1	2	2	2	31
4	1	0	4	1	5	4	4	4	2	3	5	4	37
5	1	1	6	4	8	8	14	8	4	5	8	4	71

Fig.1 gives an indication of the position of the various sites and Table II summarizes the relative values of wind, evaporation, air temperature and 2" soil temperature recorded; the 1961 shelter index is also given. For wind and evaporation, a range of relative values is given; for temperature, the values in the winter months are close to those recorded at the unsheltered weather station and the values given are the maximum monthly relative values.

Table II

Summary of results Dec. 1960-Dec. 1961

	Site 1	Site 2	Site 3	Site 4	Site 5
WIND	40-60%	50-95%	60-100%	60-100%	45-90%
EVAPORATION	65-75%	60-85%	75-100%	65-90%	55-85%
AIR TEMP.	+1°F	+3°F	0	0	+1½°F
SOIL TEMp. (2")	+4°F	+3°F	+2°F	+2°F	+3°F
SHELTER INDEX	87	68	31	37	71

/The

The records are still being kept and it is hoped that eventually values for 2 years will be available.

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FIGURE 1 POSITION OF SITES